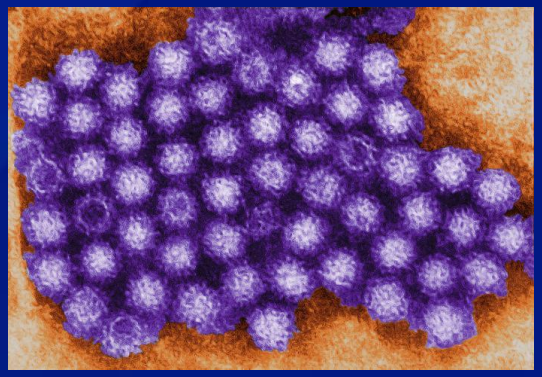
Norovirus Epidemiology and Waterborne Disease

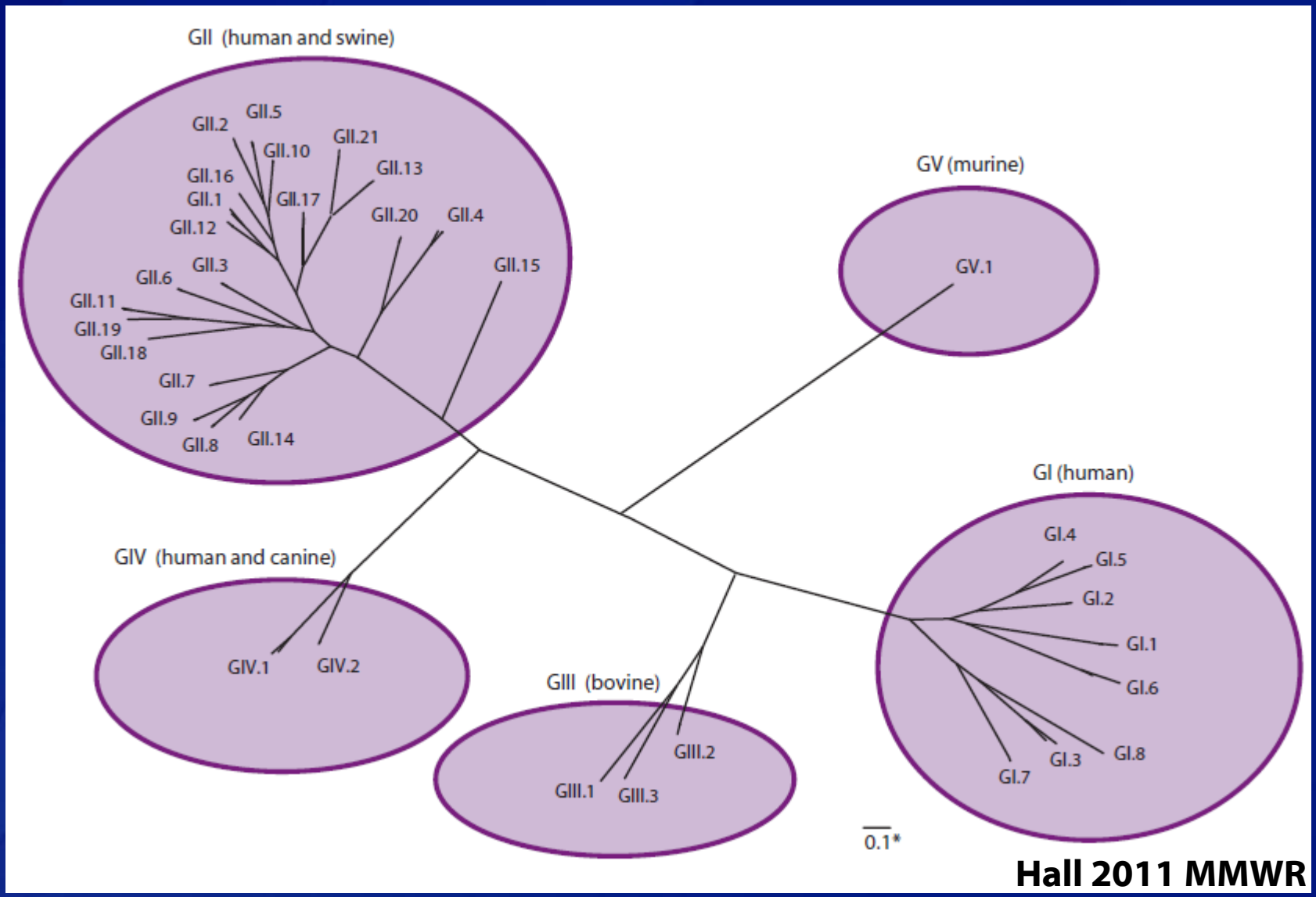


Aron J. Hall, DVM, MSPH, DACVPM
CDC Viral Gastroenteritis Team
ajhall@cdc.gov

WASH Webinar
September 14, 2011

National Center for Immunization & Respiratory Diseases
Division of Viral Diseases

Norovirus Classification



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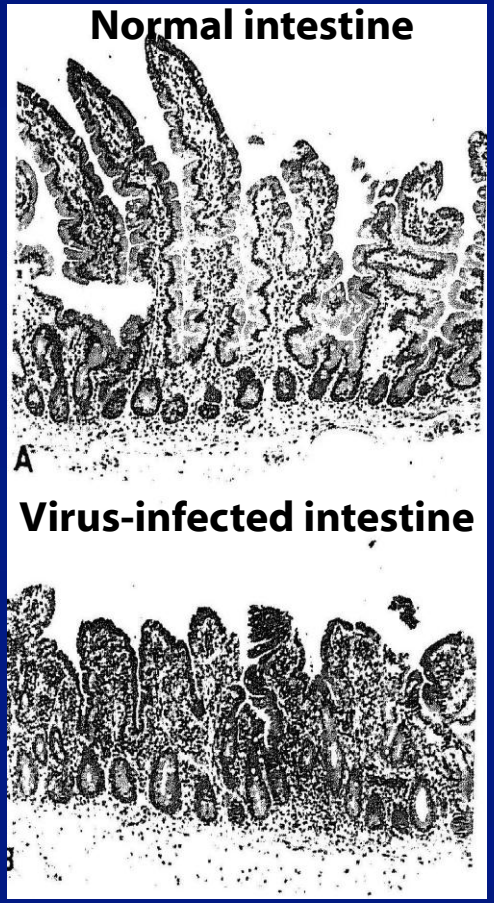
Clinical Disease

- Incubation period: 12-48 hours
- Acute-onset vomiting and/or diarrhea
  - Watery, non-bloody stools
  - Abdominal cramps, nausea, low-grade fever
- Most recover after 12-72 hours
  - 10-12% seek medical attention; some require hospitalization and fluid therapy
  - More severe illness and death possible in elderly and those with other illnesses
- 30% of infections are asymptomatic



Widdowson 2005 EID
Phillips 2010 Am J Epid
de Wit 2001 Am J Epid

Norovirus Disease Burden

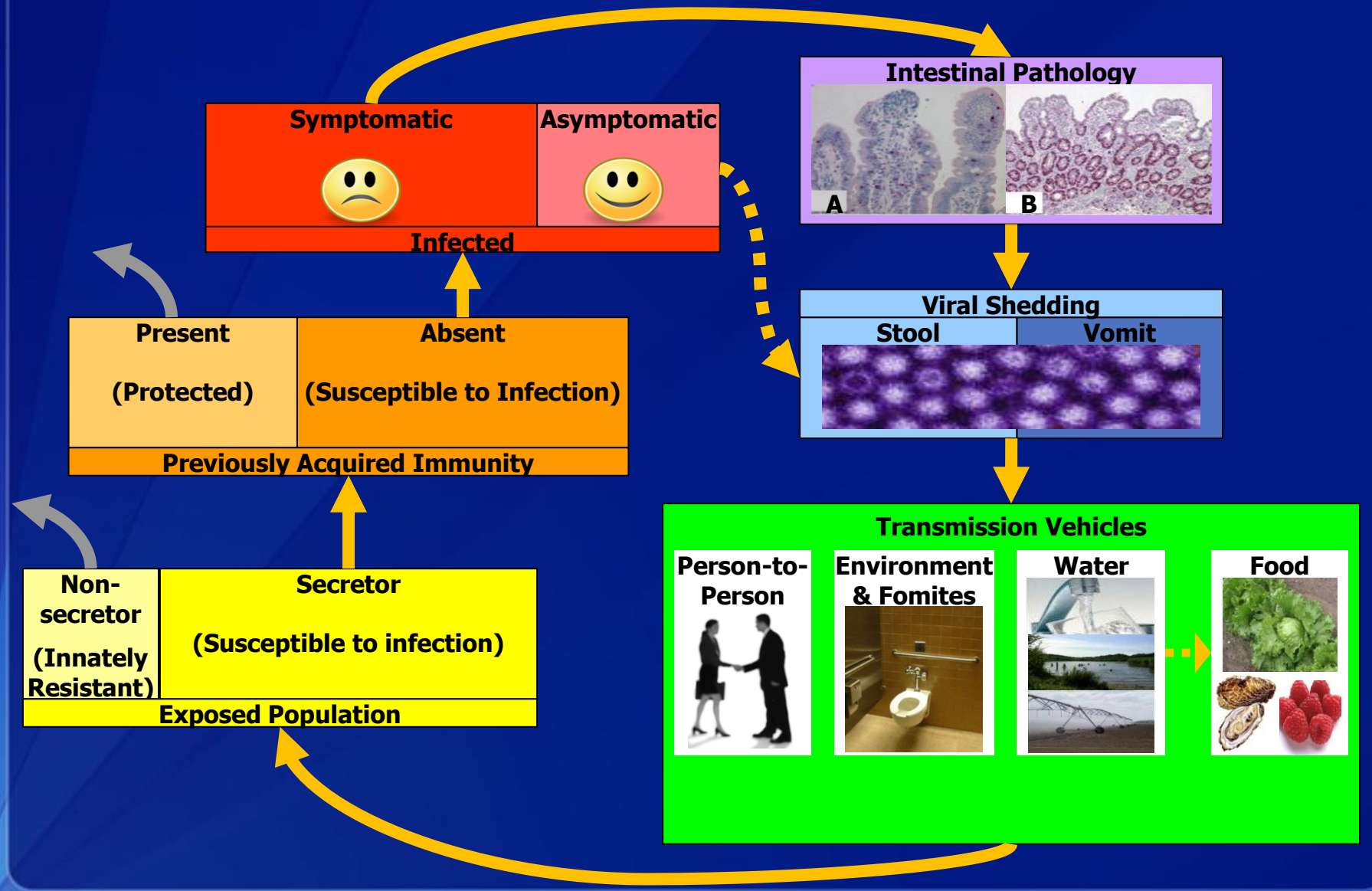
- #1 cause of acute gastroenteritis (AGE) in U.S.
  - Nearly 21 million cases annually
  - 1 in 14 Americans become ill each year
- 16% of all AGE in community and 12% of AGE among outpatients attributable to norovirus
- 71,000 norovirus-associated hospitalizations annually in U.S.
  - 18,500 (26%) in children aged <5 years
  - 28,600 (40%) in elderly aged ≥65 years
- Causes 58% of all domestically-acquired foodborne illness from known agents

Scallan 2011 EID
Hall 2011 EID
Lopman 2011 CID

Transmission

- Person to person
  - Direct fecal-oral
  - Ingestion of aerosolized vomitus
  - Indirect via fomites or contaminated environment
- Food
  - Contamination by infected food handlers
  - Irrigation or growing waters (raspberries, oysters)
- Recreational and Drinking Water
  - Well contamination from septic tank
  - Chlorination system breakdown

Norovirus Transmission Cycle



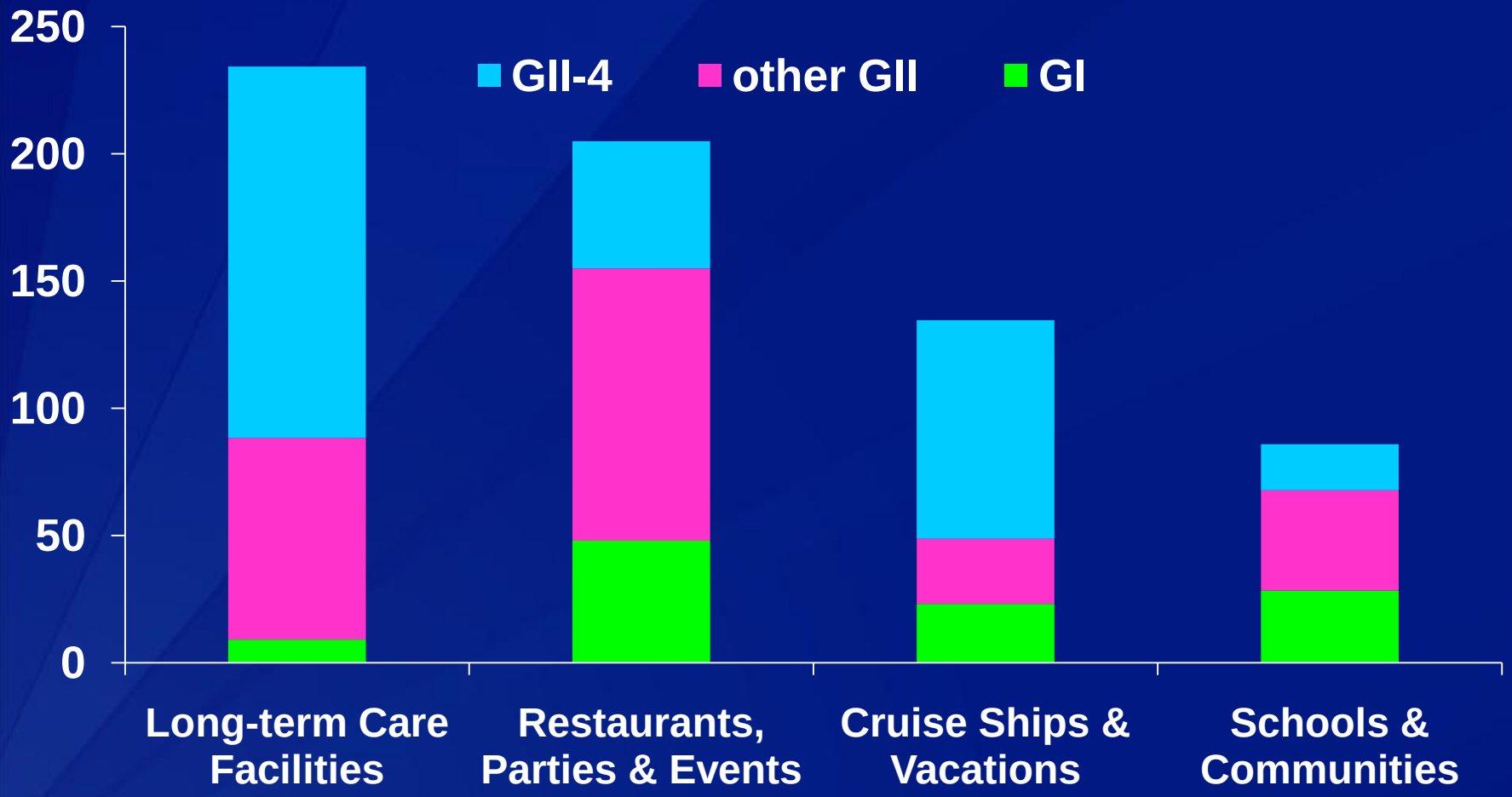
Characteristics of AGE Outbreaks Reported to CDC by 30 States, Jan 2007-April 2010

Description	All States No. (%)	State-Specific % Median (Range)
All AGE outbreaks (n=7,734)		
Suspected norovirus outbreaks	5,737 (74)	75 (23–100)
Suspected norovirus outbreaks		
Laboratory-confirmed	2,866 (50)	58 (8–100)
Occurring in long-term care facilities*	3,532 (68)	62 (12–94)
Person-to-person transmission†	3,733 (79)	78 (28–100)

*2 states excluded due to lack of reporting; 5,201 total suspected norovirus outbreaks reported by 28 states included
†1 states excluded due to lack of reporting; 4,742 total suspected norovirus outbreaks reported by 29 states included

Yen 2011 CID

Setting of Norovirus Outbreaks Reported to CDC for Diagnostic Testing, 1994-2006



Zheng 2010 JCM

Emergent GII.4 Norovirus Variants

Variant	Years of Circulation	Pandemic Season	Other Names
95/96-US	1995–2002	1995–1996	Grimsby
Farmington Hills	2002–2005	2002–2003	2002
Hunter	2003–2006	None	2004
Yerseke	2006–2008	2006–2007	Laurens, Nijmegen, 2006a
Den Haag	2006–present	2006–2007	Minerva, 2006b
New Orleans	2009–present	None*	

*Based on data available as of September 2010, the New Orleans GII.4 variant has not been associated with an increased number of norovirus outbreaks in the U.S.

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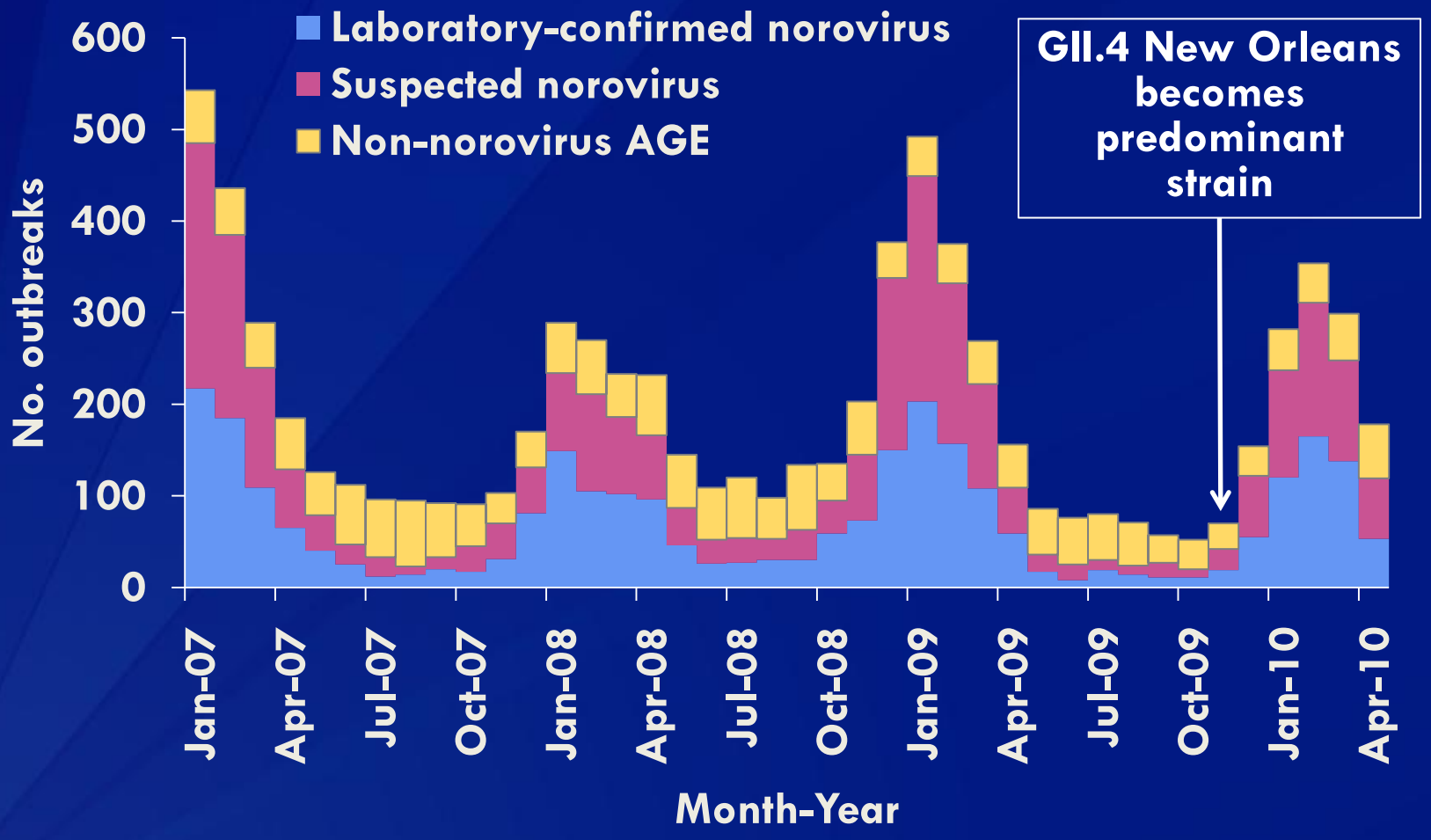
Seasonality of AGE Outbreaks Reported to CDC by 30 States, Jan 2007-April 2010



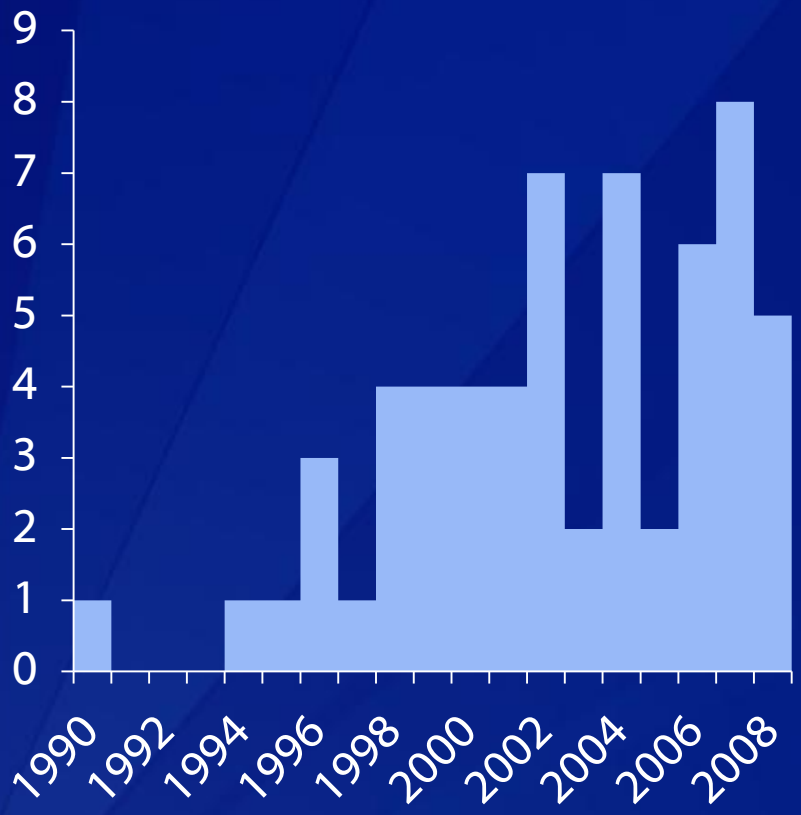
Yen 2011 CID

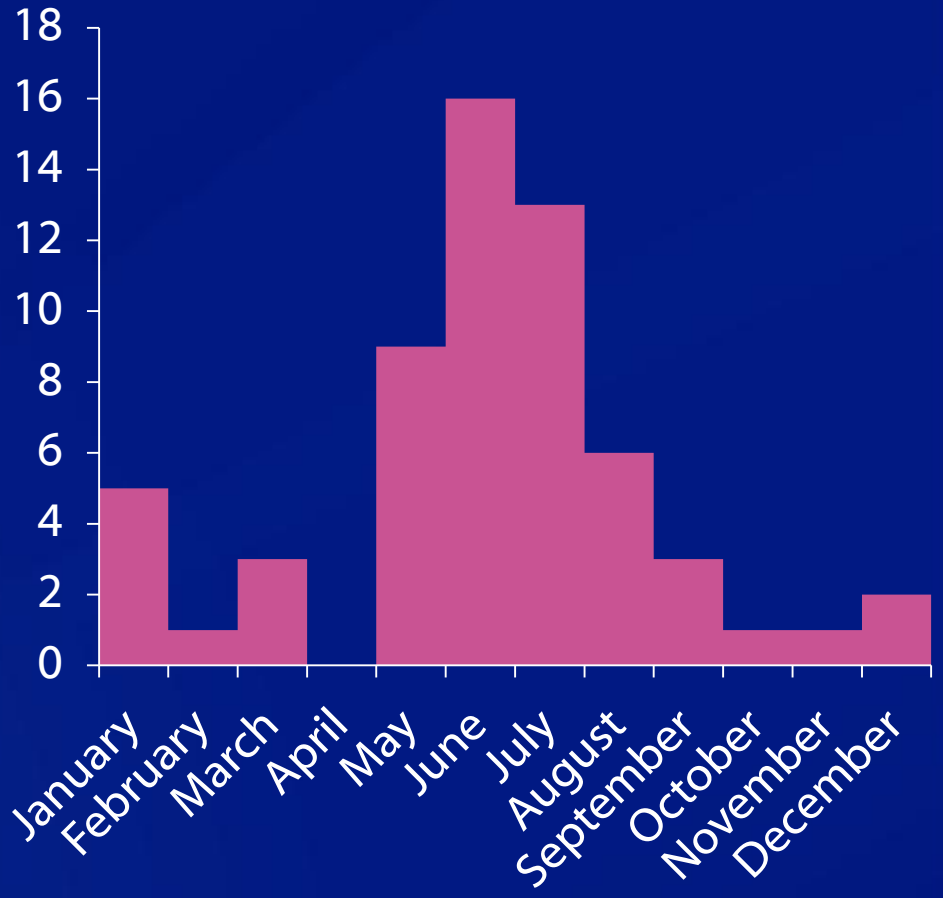
Waterborne Norovirus Outbreaks Reported to CDC, 1990-2008

- 60 (7%) of 896 waterborne disease outbreaks involved norovirus, resulting in 6162 illnesses
  - Recreational water outbreaks: 37 (62%)
    - Median 23 illnesses/outbreak (range: 6-650)
    - 26 (70%) untreated, 11 (30%) treated
  - Drinking water outbreaks: 22 (37%)
    - Median 109 illness/outbreak (range: 32-1450)
    - 18 (82%) non-community, 4 (18%) community
  - Outbreaks involving non-recreational water not intended for drinking: 1 (2%)

CDC 2011 WBDOSS

Waterborne Norovirus Outbreaks Reported to CDC, 1990-2008





CDC 2011 WBDOSS

CDC Role During Outbreaks

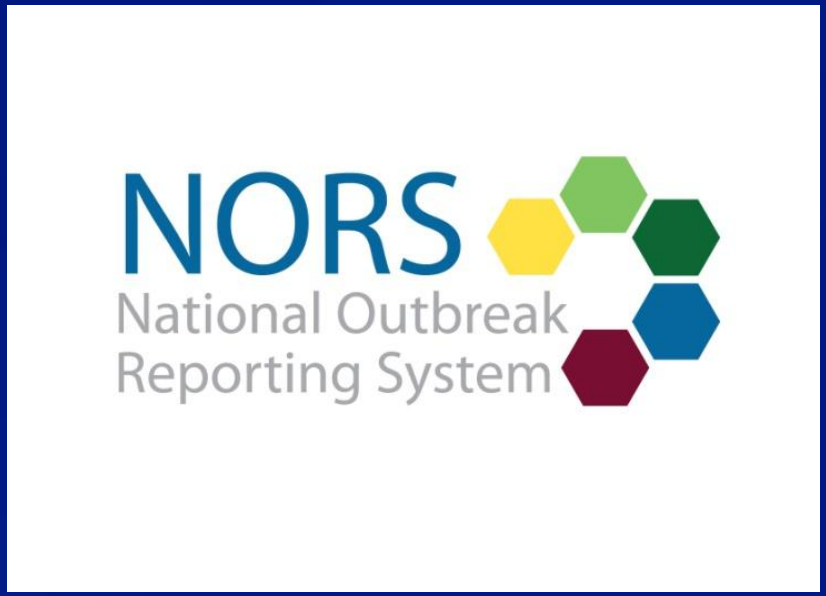
- **Consultation, multi-state coordination, and assistance**

Type	Program	Contact	Phone	Email
Norovirus Epidemiology	Viral Gastroenteritis Team	Aron Hall	404-639-1869	ajhall@cdc.gov
Waterborne Epidemiology	Domestic WASH Epidemiology Team	Jonathan Yoder	404-718-4696	jey9@cdc.gov
Clinical specimens	National Calicivirus Laboratory	Nicole Gregoricus	404-639-1923	frv6@cdc.gov
Water samples	WASH Laboratory	Vincent Hill	404-718-4151	veh2@cdc.gov

- **National outbreak surveillance**
  - **NORS (epidemiology)**
  - **CaliciNet (laboratory)**

National Outbreak Reporting System (NORS)

- Comprehensive national surveillance system for all enteric disease outbreaks
  - Web-based reporting by state and local health departments
  - Includes food, water, person-to-person, environmental, and animal transmission
- Launched February 2009

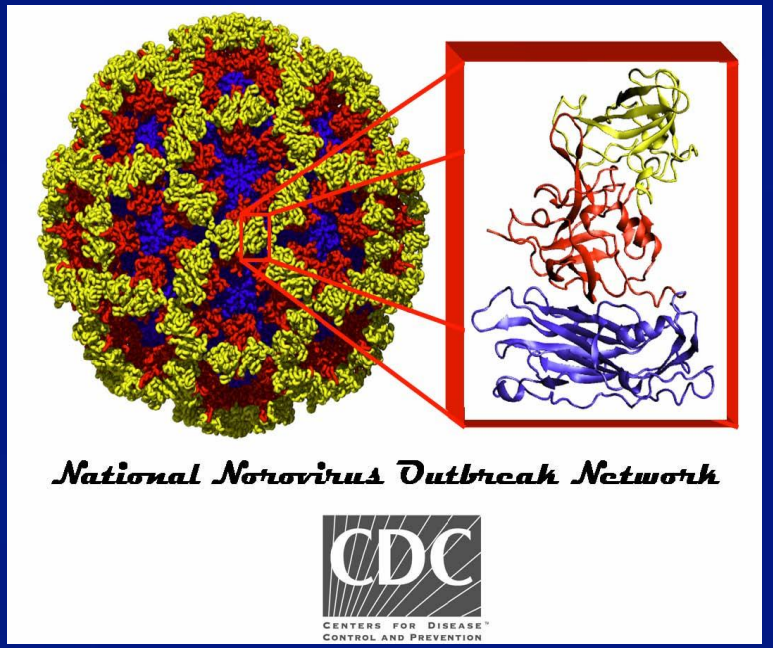


Uses of NORS Data

- Characterize the national burden of epidemic gastroenteritis, including norovirus outbreaks
- Monitor temporal trends in enteric disease outbreaks
- Identify priority settings and populations for interventions
- Characterize attribution of enteric disease outbreaks by:
  - Pathogen and sero-/geno-type
  - Modes of transmission (e.g., % waterborne)
  - Deficiencies, water sources, water types, etc.

CaliciNet

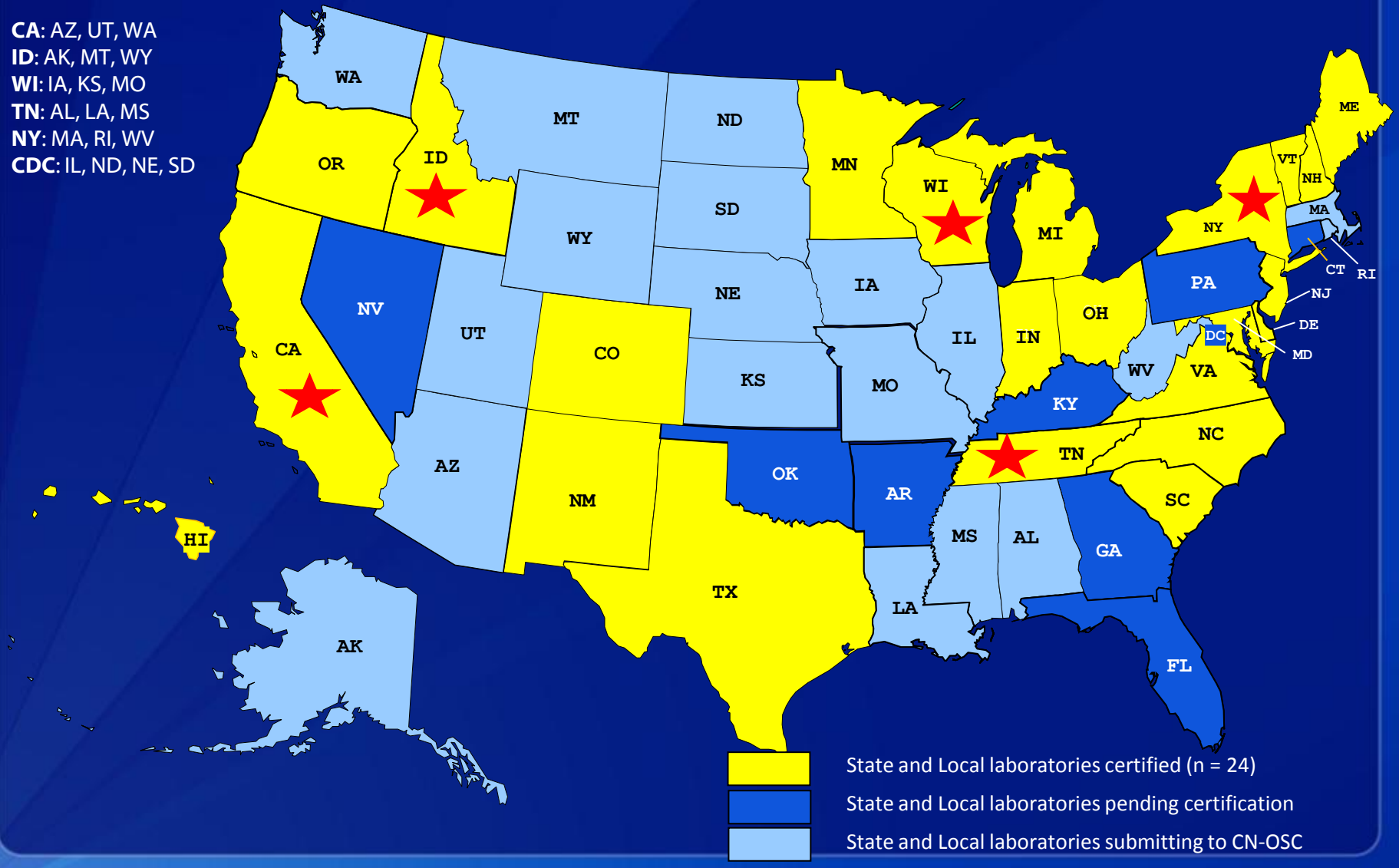
- Molecular subtyping network (like PulseNet)
- Data shared between public health labs and CDC
- Link outbreaks and identify common sources
- Identify emergent variants
- Implemented March 2009
- Currently 24 states certified



States participating in CaliciNet (May 2011)

= Outbreak Support Centers (OSC)

CA: AZ, UT, WA
ID: AK, MT, WY
WI: IA, KS, MO
TN: AL, LA, MS
NY: MA, RI, WV
CDC: IL, ND, NE, SD



Updated: 05/11/2011

Prevention and Control

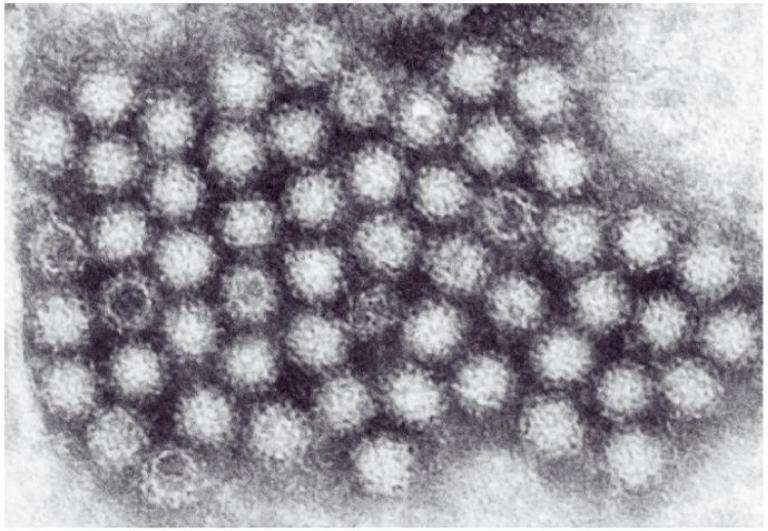
- Rapid reporting, response, and investigation
  - Identify mode of transmission and source of contamination
  - Collect appropriate specimens
- Promote appropriate hand hygiene
  - Wash with soap and water ≥ 20 seconds
  - Alcohol-based hand sanitizers?
- Prompt and thorough disinfection
  - Bleach solution for contaminated surfaces
  - Other EPA-approved disinfectants?
- Manage and exclude ill persons
  - ≥ 24-72 hrs after symptom resolution
  - Accommodating sick pay/leave policies for staff

Hall 2011 MMWR

http://www.cdc.gov/mmwr/pdf/rr/rr6003.pdf

Centers for Disease Control and Prevention
MMWR
Morbidity and Mortality Weekly Report
Recommendations and Reports / Vol. 60 / No. 3
March 4, 2011

Updated Norovirus Outbreak Management and Disease Prevention Guidelines



Continuing Education Examination available at http://www.cdc.gov/mmwr/cme/conted.html

U.S. Department of Health and Human Services
Centers for Disease Control and Prevention

Additional Norovirus Information at www.cdc.gov

Norovirus Illness: Key Facts

Norovirus—the stomac

- Norovirus is a highly contagious illness c
  It is often called by other names, such as
  poisoning.
- Norovirus infection causes acute gastroe
  intestines); the most common symptom
- Anyone can get norovirus, and they can
  lifetime.
- Norovirus is the most common cause of

Norovirus illness can be

- Norovirus can make people feel extreme
  a day.
- Most people get better within 1 to 2 day
- Dehydration can be a problem among s
  the very young, the elderly, and people

Norovirus

Surveillance & Disease Burden

Norovirus is a common illness in the United States

- CDC estimates that over 20 million cases of acute gastroenteritis every year are due to norovirus.
- Over half of all foodborne disease outbreaks are caused by noroviruses. Foods commonly involved in outbreaks include leafy greens and raw shellfish; however, any food item served raw or handled after being cooked can become contaminated with norovirus.

Norovirus outbreaks occur in diverse places

- Of 660 outbreaks with specimens confirmed by CDC for viral testing between 1994 and 2006,
  - 36% were from long-term care facilities (e.g., nursing homes),
  - 31% were from restaurants, parties, and events,

Norovirus

Facts for Food Handlers

Norovirus—the "stomach bug"

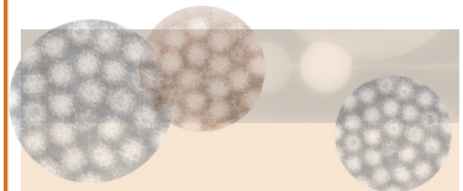
Infection with norovirus causes gastroenteritis (inflammation
intestines), which most commonly results in diarrhea, vomitir
cramping. Norovirus illness is sometimes referred to as "stoma
the flu, which is a respiratory illness caused by the influenza v

You can be infected with norovirus more than once in your lif
that there are many different types of noroviruses, and being
not always protect against infection from another type. In ad
from natural infection is thought to last for only a year or less.

Food handlers can spread norovirus

Norovirus in Healthcare Facilities Fact Sheet

Released December 21, 2006



General Information

Virology

Noroviruses (genus Norovirus, family Caliciviridae) are a group of related, single-stranded RNA, non-enveloped viruses that cause acute gastroenteritis in humans. Norovirus was recently approved as the official genus name for the group of viruses provisionally described as "Norwalk-like viruses" (NLV). Currently, human noroviruses belong to one of three norovirus genogroups (GI, GII, or GIV), each of which is further divided into >25 genetic clusters

Diagnosis of norovirus infection

Diagnosis of norovirus infection relies on the detection of viral RNA in the stools of affected persons, by use of reverse transcription-polymerase chain reaction (RT-PCR) assays. This technology is available at CDC and most state public health laboratories and should be considered in the event of outbreaks of gastroenteritis in healthcare facilities. Identification of the virus can be best made from stool specimens taken within 48 to 72 hours after onset of symptoms, although good results can be obtained by using RTPCR on samples taken as long as 7 days after symptom onset. Other methods of diagnosis, usually only available in research settings, include electron microscopy and serologic assays for a rise in titer in paired sera collected at least three weeks apart. Commercial enzyme-linked immunoassays are available but are of relatively low sensitivity, so their use is limited to diagnosis of the etiology of outbreaks. Because of the limited availability of timely and routine laboratory diagnostic methods, a clinical diagnosis of norovirus infection is often used, especially when other agents of gastroentertis have been ruled out.

Acknowledgments

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